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TREATMENT OF SELF-INJURIOUS BEHAVIOR USING A WATER MIST: INITIAL RESPONSE SUPPRESSION AND GENERALIZATION

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This study evaluated the effects of a fine mist of water applied to the face contingent upon self-injurious behavior (SIB) exhibited by profoundly retarded persons. In Experiment 1, results of individual reversal designs showed substantial reductions in a variety of SIB's (mouthing, hand biting, skin tearing, and head banging) for seven participants. In Experiment 2, two participants who frequently bit their hands were each observed in two different settings. Following initial baselines in each setting, a series of manipulations was undertaken to compare the effects of mild verbal punishment ("No") with those of a combined treatment ("No" plus mist procedure). Results in one setting indicated that "No" suppressed SIB only after it was first paired with the water mist. Data also suggested that, once acquired, the punishing properties of "No" could be extended to a second setting in which the mist was never applied, and that these effects could be generalized across therapists. Results of these experiments indicate that the water mist procedure may be an effective alternative to traditional punishment techniques. Although conclusions regarding generalization are limited due to the brevity of the maintenance conditions, the data suggest that treatment gains may be transferred to more acceptable forms of social punishment and reinforcement.

DESCRIPTORS: punishment, retardation, self-injurious behavior, water mist

Self-injurious behavior (SIB), defined as "behavior which produces physical injury to the individual's own body" (Tate & Baroff, 1966), is a serious and pervasive problem among severely and profoundly retarded persons. Surveys have indicated that approximately 10% to 17% of the institutionalized retarded exhibit some form of SIB (Baumeister & Rollings, 1976; Schroeder, Schroeder, Smith, & Dalldorf, 1978). Moreover, attempts to develop systematic treatments to reduce SIB have been both numerous and varied, ranging from relatively innocuous procedures such as differential reinforcement of other behaviors (DRO) (Lovaas, Freitag, Gold, & Kassorla, 1965; Peterson & Peterson, 1965) to more drastic techniques such as electric shock (Corte, Wolf, & Locke, 1971; Lovaas & Simmons, 1969).

In response to growing concerns in the area of treatment ethics, recent behavioral guidelines adopted by the National Association for Retarded Citizens (NARC) have emphasized the use of procedures regarded as least restrictive: differential reinforcement, extinction, exclusion time out, response cost, and overcorrection (May, Risley, Twardosz, Friedman, Bijou, Wexler, et al., 1975). In general, the guidelines reflect a timely and thorough analysis of existing legal and scientific literature, and recent applied research in the area of SIB has been most notable

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in its attempt to discover treatments meeting the criteria of both effectiveness and social acceptability (Carr, Newsom, & Binkoff, 1976; Favell, McGimsey, & Jones, 1978; Rojahn, Mulick, McCoy, & Schroeder, 1978). However, although the continued refinement of reinforcement-based procedures remains critical, additional research on the use of more restrictive techniques is also warranted. Punishment has been found to be the most consistent of all behavioral treatments in reducing SIB (Baumeister & Rollings, 1976; Russo, Carr, & Lovaas, 1980), and in cases where DRO, extinction, etc., are either ineffective or exceedingly slow acting, punishment may represent one of the few alternatives.

The purpose of the present study was to provide an initial controlled evaluation of a punishment procedure, the application of a fine mist of water to the face via spray bottle, in suppressing SIB. Experiment 1 examined the effects of the spray mist alone on a variety of SIBs exhibited by seven profoundly retarded subjects. Experiment 2 compared the mist to other less restrictive techniques and examined generalization of treatment effects across settings and therapists.

EXPERIMENT 1

METHOD

Participants and Setting

Seven profoundly retarded residents of a private nursing facility who exhibited high rates of SIB within their natural environment participated. All were nonambulatory and confined to wheelchairs, which they were unable to manipulate. Previous unsuccessful attempts at eliminating these behaviors in all seven participants during educational classes included: chemotherapy, restraint, differential reinforcement of other behaviors (DRO), differential reinforcement of specific incompatible behaviors (DRI), and time out.

1. Judy was a 5-year-old female, institutionalized since age 1.5. She had impaired hearing and vision and exhibited major seizures. Her mother indicated the presence of a repetitive hand-in-mouth (mouthing) response prior to admission to the facility. Physical damage to her hands and face due to repetitive mouthing resulted in reduced use of her hands, the development of sores and callouses, and displacement of teeth which interfered with eating.

2. Linda was a 10-year-old female, institutionalized since age 4. She had major impairments of both hearing and vision. Her target behavior was a repetitive mouthing response that generally precipitated instances of vomiting. There was no indication of the history of this behavior in her records.

3. Cassie was a 37-year-old female, institutionalized since age 10. She had no speech and exhibited no instruction-following responses. The first indication of a repetitive mouthing response, her target behavior, had been recorded in a psychological report when she was age 17. Damage to both her face and hands were noted similar to that of Judy.

4. Fred was a 19-year-old male, institutionalized since age 3. His physical condition included severe quadriplegia and both hearing and vision impairments. There was no indication of a history of the target behavior, mouthing, in the subject's records. Physical damage to both the hands and face was also noted in this subject.

5. Sally was a 26-year-old female, institutionalized since age 4. She showed no indication of hearing or visual impairment but exhibited no instruction-following responses. No history of her self-injurious behavior, hand biting, was included in her records, although the condition of her hands suggested a long history.

6. Pat was a 25-year-old female, institutionalized since age 3, who exhibited major motor seizures. A verbal report from her mother indicated she had engaged in self-injurious and aggressive behaviors for about 5 years. Her target behavior was one in which she would tear portions of flesh from her lip and forearm.

7. Shelley was a 13-year-old female, institutionalized since age 1.5. She engaged in head banging which was noted in her records upon

admission. Damage as a result of this behavior included skin abrasions and minor lesions.

All sessions were conducted in an experimental classroom, with the exception of Shelly's whose sessions were conducted in her bed. The experimental area measured approximately 1.2 m × 1.8 m and was separated from the rest of the classroom by a movable partition. Throughout the sessions, the experimenter sat facing and approximately .5 m in front of the resident. No specific toys or activities were provided participants during sessions.

Observation

The response definitions used in this study were as follows:

1. Mouthing—insertion of either hand into the mouth beyond the first knuckle (Judy, Linda, Cassie, and Fred).

2. Hand biting—insertion of either hand into the mouth beyond the first knuckle, combined with a rotating motion of the jaw indicative of chewing. This behavior was discriminable from mouthing on the basis of its visual outcomes—teeth marks and the development of open sores on the participants' hands (Sally).

3. Skin tearing—closure of the index finger and thumb in a pincerlike fashion while in contact with either the lip or forearm (Pat).

4. Head banging—any forceful contact of the head with a stationary object or other portion of the body (Shelly).

Observations were conducted by one of the experimenters assigned to a particular session or a paraprofessional staff participating in the project as part of a practicum experience. The observers were trained through instruction, modeling, and in vivo practice. Formal data collection was not begun until each observer reached a criterion performance level of 90% agreement. The occurrences of these behaviors were recorded during continuous 10-sec intervals using a partial interval observation procedure (Powell, Martindale, & Kulp, 1975). Intervals were scored positively based upon the occurrence of a target response during any portion of a given 10-sec period. A cassette tape containing prerecorded prompts was used to indicate the beginning of each interval. The percentage of intervals during which the target response occurred was obtained by dividing the positively scored intervals by the total number of intervals and multiplying by 100. All sessions were of a constant length for each participant—20 min, except for Shelly whose sessions lasted 30 min. The change for Shelly was due to an initial scheduling error which, once detected, was not altered.

Reliability

Interobserver agreement on the occurrence of each target behavior was assessed an average of every 5 sessions. During these sessions, data were taken by both the experimenter assigned to that session and another observer. The reliability observer was physically separated from the primary observer by the partition used to isolate the participants and was unable to see the primary observer's data. To reduce the possibility that the reliability observer was scoring only the consequation of the behavior and not the actual occurrence of the behavior (during treatment sessions only), consequences were delayed on a random schedule varying from 1 to 5 sec (mean = 3 sec). This delay was accomplished by having the experimenter count covertly the appropriate delay from the onset of the target behavior. A list of 30 delay lengths was given to the experimenter prior to each treatment session in which reliability was to be assessed. Such delays would allow the behavior to occur in one interval and the punisher in the next. The reliability observer, if scoring only the consequation of the behavior would miss correct intervals randomly, producing a lower agreement percentage. This procedure was followed only during treatment sessions in which reliability was being assessed and had no apparent effect on treatment outcome. Previous research suggests that such a delay procedure should not detrimentally affect response suppression (Azrin, 1956; Estes, 1944; Hunt & Brady, 1955). Agreement percentages

were calculated by dividing the number of agreements on the occurrence of the behavior on an interval-by-interval basis by the number of agreements plus disagreements and multiplying by 100. Scores ranged from 96.5% to 100% with a mean of 99.2% agreements across all participants and sessions.

PROCEDURE

Baseline

Target behaviors were observed and recorded during individual daily sessions for each participant. No contingencies were in effect for the target responses.

Water Mist

The stimulus used in this study was a fine mist of water directed toward the participant's face contingent upon the occurrence of a target SIB. Tap water was dispensed from a standard plastic plant sprayer (Canyon, U.S. Patent No. 3701478), available in most garden supply stores. The temperature of the water remained fairly constant throughout the study, varying only as a function of changes in room temperature (72°-78°F; 22°-26°C). The sprayer was adjusted to ensure a maximum misting effect (diffusion of the water as opposed to a direct stream) and held no closer than .3 m to the participant's face. Approximately .6 cc of water was dispensed with each spray. The experimenter did not interact with the participant in any other manner during the session, and at the conclusion of each session, the participant was towel dried and, if necessary, provided with a change of clothing.

EXPERIMENTAL DESIGN

ABAB reversal designs were used (Baer, Wolf, & Risley, 1968) for each participant except Shelley, who never underwent reversal due to the severity of her SIB and the length of the initial baseline needed to show stability. Although designs that do not require a reversal (e.g., multiple baseline designs) might have been more appropriate, their use was not feasible because participants entered the project at different times over a period of approximately one year, precluding the collection of concurrent baseline data across subjects.

RESULTS AND DISCUSSION

Figure 1 shows the percentage of intervals of SIB for individual participants across experimental conditions. Participants typically exhibited high rates of SIB during baseline. Although Linda, Sally, and Shelley occasionally engaged in little or no SIB during a given session, the overall trends observed during baseline suggest little change in level of responding over time. Within four sessions following the introduction of the water mist, target responses decreased to below 5% of observed intervals for all participants. SIB returned to baseline levels during reversal and decreased again during the second mist condition. When compared to initial baseline rates, the behaviors were suppressed an average of 51.5% during the initial treatment phase and 60.1% during the second treatment phase.

The results of Experiment 1 indicate that the water mist was a highly effective treatment. The data represent almost complete elimination of SIB across a variety of behaviors. Even those participants who displayed a similar response, mouthing, presented differences in terms of age, physical involvement, duration and overall percentage of responding both within and across sessions, and the degree of physical injury resulting from the response. These differences suggest that the effects observed are not entirely idiosyncratic and that, within the context of the present experiment, the stimulus appears to have generalized suppressive properties.

In addition to its effectiveness, the water mist subjectively appears to be a relatively innocuous stimulus, and might thus be more appealing than either electric shock or ammonia when other attempts to reduce SIB have failed. Experimenters and others who received applications of the mist described it as "annoying" rather than

"painful." Obviously, however, the procedure is more intrusive than other forms of punishment such as verbal reprimanding. In view of this fact, a second experiment was conducted to compart the mist with less restrictive treatments, and to determine if more socially acceptable procedures might maintain low levels of SIB following initial treatment with the mist.

EXPERIMENT 2

METHOD

Participants and Settings

Two nonambulatory residents, living in the same facility, who demonstrated high rates of SIB participated. Cindy was 21-years-old and had been institutionalized since the age of 4. Her diagnosis was profound mental retardation and severe quadriplegia due to Edward's Syndrome. Cindy was confined to a wheelchair which she was unable to manipulate. Sally, who had participated in Experiment 1, was described previously. Examination of both participants' records revealed no indication of the onset of their target SIB, hand biting; however, large callouses and inflammation suggested a long history. Several procedures, including restraint, chemotherapy, DRO, and time out, had been attempted previously to reduce the participant's SIB.

Daily sessions were conducted individually for both participants in each of two different settings. Morning sessions were held in a classroom similar to that in Experiment 1. However, no attempt was made to isolate them from environmental distractions. Participants were worked with in an open part of the classroom, in the presence of one to four other students and two teacher aides. Each participant was seated in a manner typical of that used in their other educational settings: Cindy was seated in a chair at a small table with blocks and various toys available, whereas Sally was positioned in her wheelchair. Experimenters were positioned in front of and facing the participants at a distance of approximately .6 m. Afternoon sessions were conducted in areas in which the participants spent much of their time while not in classes. Cindy's sessions were held at various locations near the nurses' station. Sally's sessions were conducted in the hallways near her bedroom. Experimenters sat a distance of approximately .6 m slightly in front of and to either side of the participant.

Observation

The definition of hand biting in this experiment was any contact of the participant's hand (from the wrist up) to the mouth. Prebaseline observations indicated that both participants almost always inserted their hands into their mouths and repeatedly moved their jaws and teeth in an up-and-down motion on various portions of the hand. Observations were conducted by one of the experimenters, a paraprofessional staff, or one of two undergraduate practicum students. Occurrences of hand biting were recorded daily for each participant during 20-min sessions in both settings. Both the observation and the methods used for observer training were identical procedures to those described previously.

Reliability

Interobserver agreement was assessed for each participant an average of every six sessions. Occurrence reliabilities were calculated using the formula described previously, and agreement scores ranged from 86% to 100% with a mean of 99.1% across participants and sessions.

PROCEDURES

Baseline

Target behaviors were recorded daily for each participant during individual sessions conducted in both settings. No contingencies were in effect for the target responses during this condition.

Verbal "No"

Contingent upon each occurrence of hand biting, an experimenter said either "No" or "No, (*participant's name*)," in a firm but normal tone of voice. If the participant's hand remained in contact with her mouth, the "No" was repeated at 10-sec intervals until the behavior ceased.

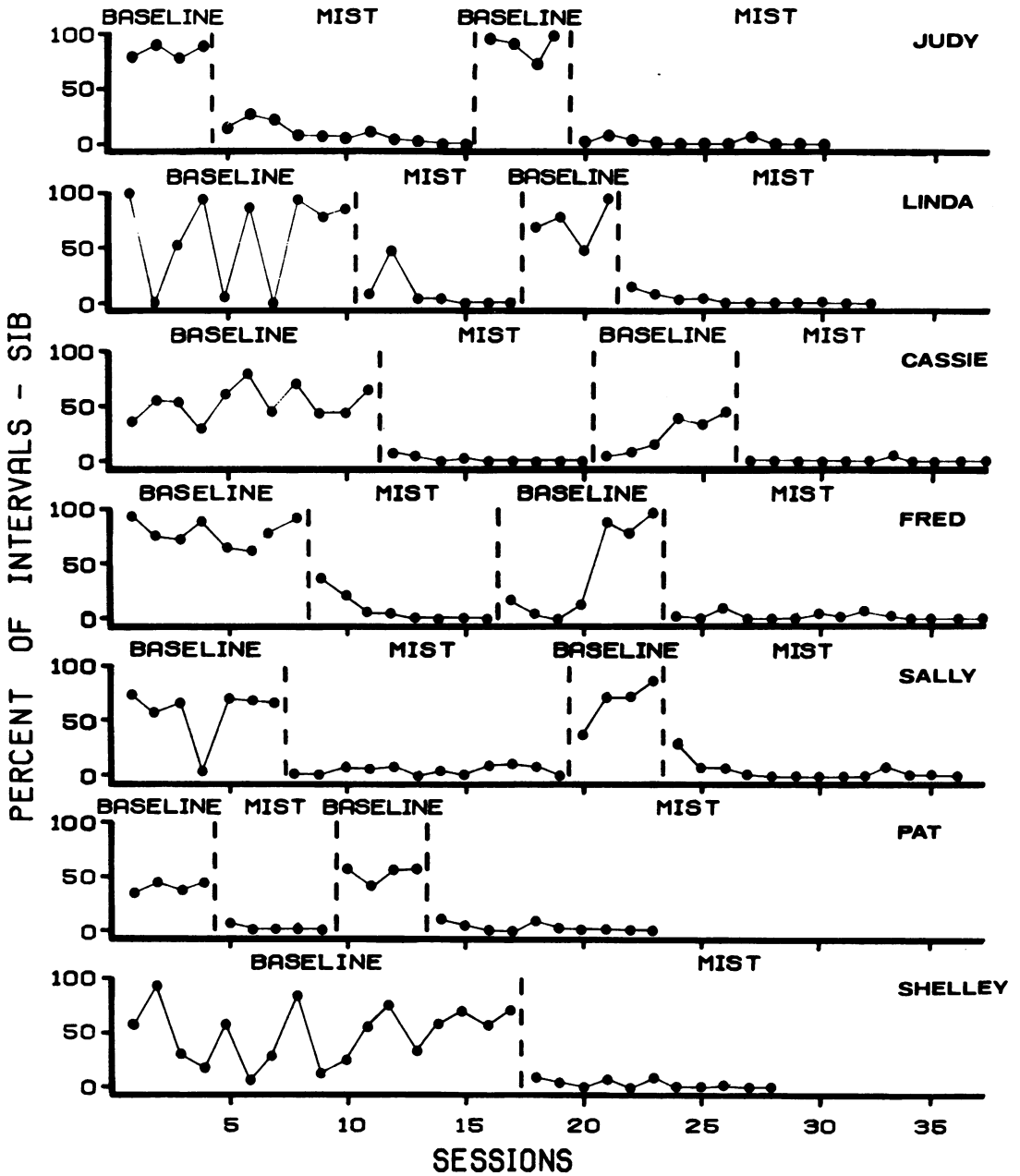

Fig. 1. Percentage of intervals of SIB across experimental conditions. The forms of SIB were: mouthing (Judy, Linda, Cassie, and Fred), hand biting (Sally), skin tearing (Pat), and head banging (Shelley).

DRO

Social reinforcement was provided on a resetting, 1-min schedule contingent upon the absence of hand biting. Praise and smiles were delivered to both participants; in addition, Cindy was "growled" at and tickled, and Sally was manually assisted in hand clapping.

Water Mist

Contingent upon each occurrence of hand biting, the water mist was directed toward the par-

ticipant's face in a manner identical to that described previously. The only difference was that in this experiment, the participant was towel dried following each application to reduce any ill effects due to chilling that might result from remaining wet throughout the sessions, and to prevent clothing from becoming wet.

Experimental Design

Following initial baselines in both settings, the verbal "No" was introduced simultaneously in both settings to test its effects as a social punisher. Next, the "No" was combined with the water mist and DRO in one setting, while a partial treatment, DRO alone, was introduced in the second setting. These conditions were implemented for two reasons: (a) in an effort to establish the "No" as a conditioned punisher (first setting), and (b) to determine the relative contribution of DRO (second setting). The water mist was later withdrawn from the first setting, but the verbal "No" plus DRO remained in effect. Concurrently, "No" was reinstated in the second setting with the ongoing DRO. During this final condition, which was implemented in a multiple baseline fashion across participants, several probes were conducted during which either DRO was not used, or treatment was administered by experimenters who had not previously been associated with the application of the mist.

Results and Discussion

Figure 2 shows the percentage of intervals of hand biting for Cindy and Sally. During baseline, Cindy's hand biting averaged 91% in the classroom and 55% in the nurses' station. The first treatment, a verbal "No," appeared to have little effect in either setting, as hand biting averaged 88% in the classroom and 94% in the nurses' station during this condition. When the "No" was combined with DRO and the mist in the classroom, hand biting immediately decreased to a mean of 6%. Concurrently, DRO alone was implemented in the nurses' station, where the behavior averaged 78%. During the final condition, "No" plus DRO were introduced in both settings. Hand biting continued at a low level (mean = 3%) in the classroom, and decreased substantially to an average of 2% in the nurses' station.

The results of treatment for Sally were similar. Her hand biting averaged 75% and 85% in the classroom and hallways, respectively, during baseline. The "No" condition produced little change in the classroom (mean = 92%), whereas some reduction was evident in the hallways (mean = 64%). Introduction of the "No" plus DRO plus mist in the classroom reduced hand biting to an average of 8%. When DRO alone was applied in the hallways, the behavior continued at a high rate similar to baseline, averaging 87% throughout the condition. As with participant 8, Sally's hand biting was almost completely eliminated in the final "No" plus DRO condition, averaging 5% in the classroom and 1% in the hallways.

The data for both Cindy and Sally show that the initial effects of a verbal reprimand ("No") contingent upon hand biting were negligible. However, the combination of "No," a 1-min DRO, and contingent water mist produced both rapid and large reductions in the behavior of both participants in the classroom setting. To control for the possibility that the effect was due primarily to the DRO procedure, DRO was implemented alone in a second setting.

Results in the nurses' station for Cindy and in the hallways for Sally suggest that DRO alone was ineffective in reducting hand biting. Several aspects of the final experimental condition should be noted. First, the mist was withdrawn from the classroom setting, and it was found that low levels of hand biting maintained. Second, the "No" plus DRO greatly reduced hand biting in the nurses' station and hallways for both Cindy and Sally, respectively, in spite of the fact that the mist had never been used in those settings. Finally, two types of probes were conducted during the final condition.

Although "No" and DRO had previously been found ineffective when used singly, it was

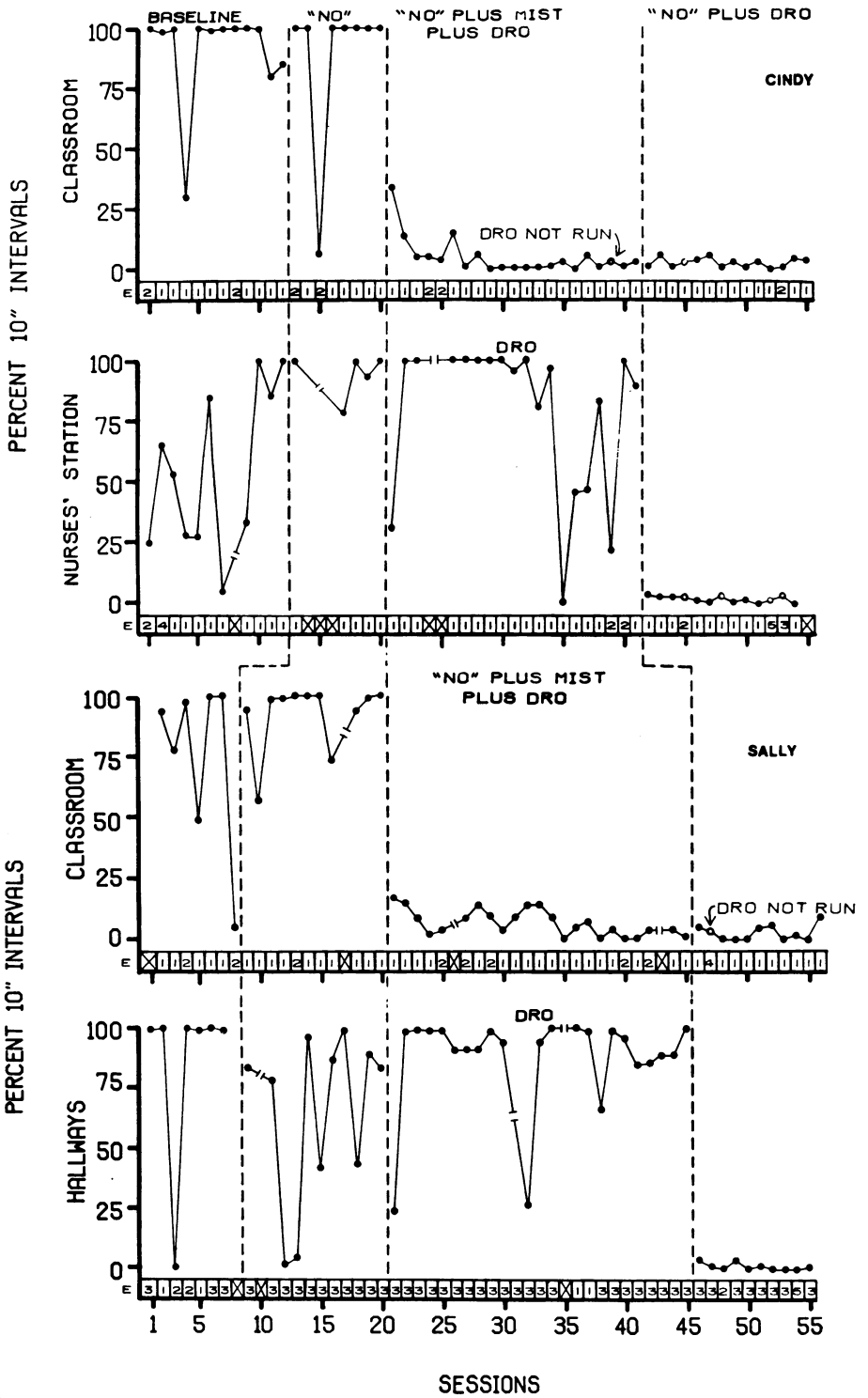

Fig. 2. Percentage of intervals of hand biting for Cindy and Sally across experimental conditions. Open data points represent sessions within a DRO condition where DRO was not used. The numbers 1 through 5 along the abscissas refer to different experimenters conducting the sessions.

conceivable that a combination of the two would lead to decreases in hand biting. Thus, results of the final "No" plus DRO condition might be unrelated to the previous use of the mist. Several probes were therefore conducted during which DRO was not applied and data from these probes were indistinguishable from other sessions. This control procedure does not clearly demonstrate the functional properties of the mist procedure because it only approximates a more lengthy condition in which "No" plus DRO would be used exclusive of the mist. However, the results of these probes do suggest that the transfer of treatment effects was more likely due to punishing properties acquired by "No," rather than the novel combination of "No" plus DRO. A second type of probe during the final condition involved the use of experimenters who had never previously administered the mist. Results of these probes showed no increases in SIB. This finding does not rule out the potential contribution of social stimulus variables in producing generalization; however, it does suggest that the behavior was not entirely under the stimulus control of the person administering punishment.

GENERAL DISCUSSION

Present results suggest that the water mist produces both rapid and substantial decreases in SIB. In addition, the data from Experiment 2 are encouraging in that the effects of the mist were transferred on a short-term basis to more socially acceptable (less restrictive) forms of treatment, and generalized across settings and experimenters.

On the basis of the present findings, the water mist technique appears to be an effective and, in some instances, a justifiable treatment. However, a number of issues should be considered prior to its use. First, the use of any punishment procedure to reduce SIB should be preceded by attempts to establish alternative behavior patterns through environmental stimulation and reinforcement (May et al., 1975). Although difficult to do in an a priori manner, it is possible that through more careful observation of the conditions under which the SIB occurs, an appropriate procedure may be selected on the basis of suspected maintaining variables (Carr, 1977).

Second, precautions must be taken to ensure client safety when using the mist. In the present study it was felt that water remaining on participants' faces and clothing might occasion or exacerbate colds or other illnesses. Therefore, sessions were not conducted if participants exhibited any cold symptoms or fevers, and participants were thoroughly towel dried and, if necessary, redressed at the end of each session. It is also possible (although not observed in any of the present participants) that prolonged facial exposure to water might produce chapped skin. In such cases, it would be important to apply a surface treatment (e.g., petroleum jelly) either before or after a session or at various times throughout the day. The distance from which the mist is delivered, and the temperature. amount, and diffusion of the water should also be taken into consideration.

Third, the present experiments did not demonstrate the establishment of behavioral alternatives to SIB. Because of a number of administrative, practical, and methodological concerns, the studies focused solely on the initial and short-term generalized effects of an alternative punishment procedure. Thus, stimulation and educational programs were implemented by other staff throughout the day, and no attempt was made to teach specific adaptive responses during experimental sessions, nor were data collected on the occurrence of these responses. Our inability to make confident empirical statements regarding client gain in other areas is a weakness in the present research. Because treatment goals in applied settings include not only the reduction of inappropriate behavior but also the development of specific skills, reinforcement procedures aimed at developing and strengthening adaptive responses must not be overlooked in spite of the fact that they may be initially ineffective in eliminating problematic behaviors such as SIB. Where possible, these procedures should be in-

corporated directly into treatment settings where punishment will be administered, so that the major focus of therapy would be skill acquisition with punishment as an adjunctive technique.

Finally, although Experiment 2 demonstrated generalization of treatment effects for relatively brief periods across controlled settings, neither long-term maintenance nor generalization across the entire day was attempted. It must be emphasized that all-day generalization should not be expected unless specific procedures are employed to promote long-term transfer. Several were included in Experiment 2: the pairing of the mist with "No" plus DRO in the original treatment setting, the continued use of "No" plus DRO when the mist was later withdrawn, and the inclusion of experimenters previously associated with the mist during many sessions within the generalization phase of the experiment. Data from other studies using shock suggest that additional procedures, such as pairing the primary punishing stimulus with a number of experimenters/caretakers and the use of the primary stimulus in a number of settings, may be necessary to produce generalization to more naturalistic settings (Birnbrauer, 1968; Corte et al., 1971; Lovaas & Simmons, 1971).

Future research on the use of the water mist in open environments should be undertaken before ward-wide application could be recommended. Variations in the application of the mist itself may be required. In addition, the ease and accuracy with which the mist could be applied, as well as additional safety precautions needed, are issues that warrant further examination. Data from the present investigation provide a strong basis for more extended evaluations of the water mist as a temporary, facilitative component in the comprehensive treatment of SIB.

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